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On the occurrence of *Neorossia caroli* (Jouben, 1902) in the central Adriatic Sea (Croatian waters)

Svjetlana KRSTULOVIĆ ŠIFNER *, Igor ISAJLOVIĆ and Nedo VRGOČ

Institute of Oceanography and Fisheries, P.O. Box 500, 21 000 Split, Croatia

** Corresponding author, e-mail: sifner@izor.hr*

*Two specimens of *Neorossia caroli* have been recorded for the first time in the central Adriatic Sea. They were caught in summer 2004 with a bottom-trawl net during a single tow at depths between 449 and 594 m in Croatian waters. Up to now *N. caroli* has never been found in the central Adriatic area. This finding represents a northernmost extension in the known range of the species *N. caroli* in the Adriatic Sea. Recorded specimens were both adult and mature males with mantle lengths of 42 and 37 mm. They counted 21 and 16 spermatophores, respectively. The measurements from both individuals are reported, including beak standard dimensions.*

Key words: Cephalopoda, Sepioidea, *Neorossia caroli*, northernmost occurrence, Adriatic Sea

INTRODUCTION

Neorossia caroli (Joubin, 1902) is a cephalopod species of the order Sepioidea and family Sepiolidae. Morphological characteristics of the species are: large head, rounded posterior end of mantle, arm suckers in 2 rows, chromatophores on the funnel (MANGOLD-WIRZ, 1963) and absence of a functional ink sac (BOLETZKY, 1971).

This benthic species inhabits depths between 300 and 800 m, although it was also recorded in shallower waters (less than 200 m) in the southeastern Adriatic region (PASTORELLI *et al.*, 1998). It inhabits the eastern Atlantic from southwestern Iceland and Ireland to the Gulf of Guinea, the northwestern Atlantic and the Great Australian Bight (NESIS, 1987). This species is common in the western Mediterranean (MANGOLD &

BOLETZKY, 1987) as well as in the Aegean Sea (D'ONGHIA *et al.*, 1996; SALMAN *et al.*, 1997; LEFKADITOU *et al.*, 2004). It was recorded in the eastern Ionian Sea (LEFKADITOU *et al.*, 2003; KRSTULOVIĆ ŠIFNER *et al.*, 2005) while it has not been fished in the Gulf of Taranto (BELLO, 1987).

The first records of this species in the Adriatic Sea are from the southwestern part (BELLO, 1988; 1990) and it was subsequently also fished in the southeastern part (KRSTULOVIĆ ŠIFNER *et al.*, 2005). Considering the eastern side of the Adriatic Sea, based on records from the available literature, it seems that this species has never been found, up to now, northern of Albanian waters (STJEPČEVIĆ, 1969, 1970; GAMULIN-BRIDA & ILIJANIĆ, 1972; MANDIĆ, 1973, 1984; CASALI *et al.*, 1998; KRSTULOVIĆ ŠIFNER *et al.*, 2005) despite the systematic trawling on the eastern Adriatic slope

during the last decade (KRSTULOVIC ŠIFNER *et al.*, 2005).

These findings represent a northernmost extension in the known range of *N. caroli* in the Adriatic Sea and the first record of this species in Croatian waters.

MATERIAL AND METHODS

Two individuals of the species *N. caroli* were caught by a bottom-trawl net on August 7th, 2004 (Fig. 1). The depth was 449 m (42°26'20" N; 17°42'46" E) at the beginning and 491 m (42°26'06" N; 17°38'54" E) at the end of the trawling at this station (duration 60 min). However, during the trawling, a depth of 594 m was recorded (42°26'03" N; 17°40'33" E)

(Fig. 2). Both specimens are preserved at the Institute of Oceanography and Fisheries in Split. The species was identified using the key of MANGOLD & BOLETZKY (1987).

The following measurements were taken on board: total length (TL), mantle length (ML) and body weight (BW) (0.01g). For each individual sex and the stage of gonad maturity was noted. Measurements of arms and spermatophores were taken after preservation in 4% formalin solution. Measurements of the beaks of these two individuals were taken according to CLARKE (1986). Two individuals were insufficient to obtain regression by comparing these measurements. All measurements for both individuals are presented (Table 1).

Table 1 Body measures of two specimens of *N. caroli* collected in the eastern Adriatic in 2004: BW–body weight, TL1–total length without tentacles, TL2–total length with tentacles, ML–mantle length, AL–arm length, TEL–tentacle length.

BW (g)	TL1 (mm)	TL2 (mm)	ML (mm)	AL1 (mm)	AL2 (mm)	AL3 (mm)	AL4 (mm)	TEL (mm)
25.18	116	260	42	17 (broken)	43	47	42	171
24.08	107	231	37	26	41	43	40	157



Fig. 1. Two specimens of *N. caroli* photographed on board

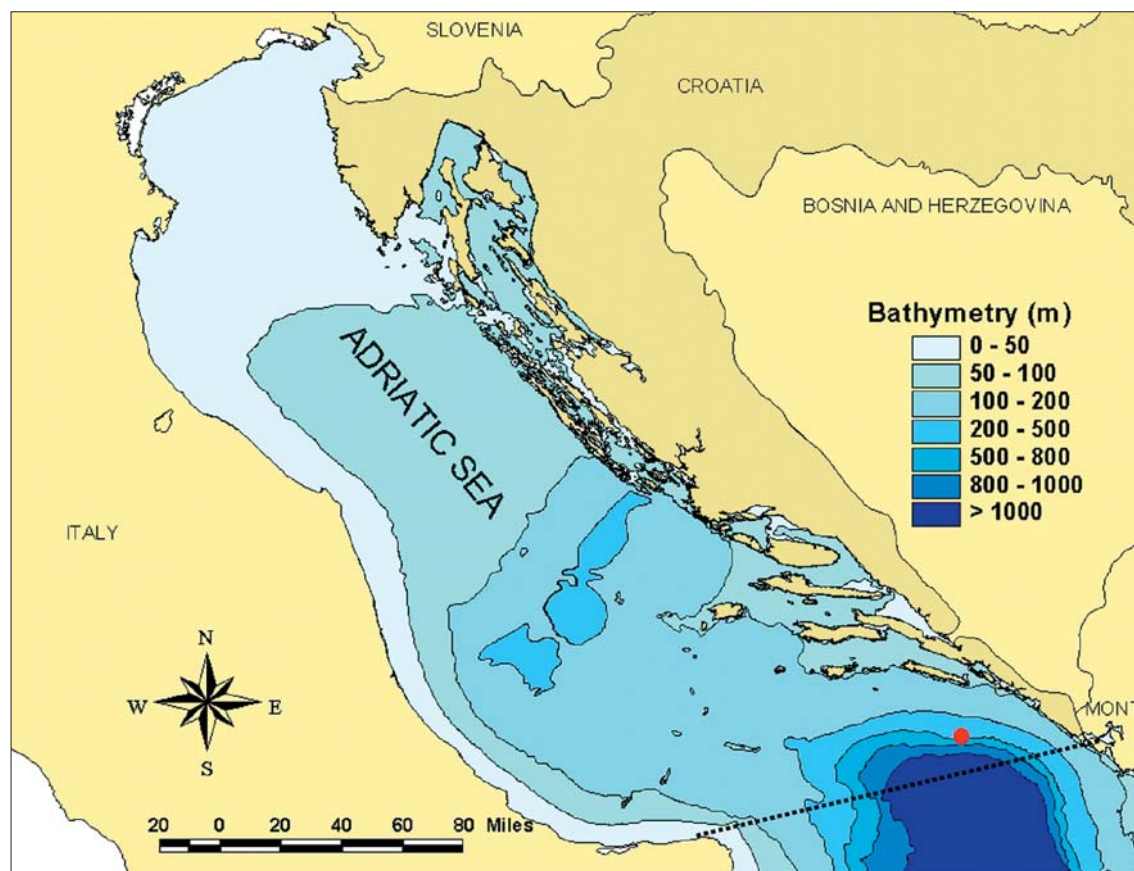


Fig. 2. Map of the northern and central Adriatic Sea showing the locality where *N. caroli* was found (dotted line – division of the Adriatic Sea according to GFCM: northern and central Adriatic sub-area and southern Adriatic sub-area)

RESULTS AND DISCUSSION

Two individuals of *N. caroli* were caught during a single haul at depths between 449 and 594 m. One had a mantle length of 42 mm and the other of 37 mm. Both specimens were mature males. In their spermatophoric sacs, 21 and 16 spermatophores were counted respectively (Fig. 3). The length of spermatophores ranged between 9.5 and 21.7 mm and the average length was 13.85 mm (SD=2.96). The measurements of the bodies and beaks for both

specimens are presented in Tables 1 and 2. The value of the wing/rostral edge ratio of the lower beak was 2.59 for both specimens proving that this species, as all other Sepiolids, have a long wing. The crest/hood ratio was 1.97 and it is in the known crest/hood ratio range of the family Sepiolidae (CLARKE, 1986).

New records of *Neorossia caroli* from the Adriatic Sea confirm that this species inhabits deeper waters. Although the area of distribution of this species ranges between 300 and 800 m (MANGOLD & BOLETZKY, 1987), there are

Table 2 Beak measures (in mm) of the specimens of *N. caroli* caught in Croatian waters in 2004: U-upper beak, L-lower beak, CL – crest length, HL – hood length, WL-wing length, REL-rostral edge length (A - ML =42 mm, B - ML=37 mm).

	UCL	UHL	UWL	UREL	LCL	LHL	LWL	LREL
A	6.71	5.37	3.54	1.96	5.65	2.87	4.27	1.62
B	6.68	5.31	3.53	1.90	5.61	2.84	4.08	1.60



Fig. 3. Spermatophore of *N. caroli* (specimen ML=37 mm). Each line on the bottom measures 1 mm

records from depths shallower than 200 m in the Adriatic Sea (PASTORELLI *et al.*, 1998). There are no previous data on occurrences of this species in the central Adriatic Sea, but it has been recorded in the eastern and western part of the south Adriatic area (BELLO, 1990; PASTORELLI *et al.*; 1998; KRSTULOVIĆ ŠIFNER *et al.*, 2005). This northernmost occurrence could be related to climatic changes and the hydrographic features of the Adriatic Sea (MANCA *et al.*, 2005). The periods of intense influx of Mediterranean waters into the Adriatic, termed «Adriatic ingressions» and characterized by an increase in salinity and temperature (ZORE-ARMANDA, 1981), seem to be linked with some rare occurrences in the marine life (BELLO, 1990). MANDIĆ (1984) found

that temperature is a very important factor in determining the distribution and displacement of south Adriatic cephalopods, and it has already been noted that the area of distribution of several thermophilic fish species has been extended to the north (DULČIĆ & GRBEC, 2000; DULČIĆ *et al.*, 2004). The described specimens of *N. caroli* were caught at the northern edge of the south Adriatic pit, while in the southwestern region it was also recorded on the continental shelf (PASTORELLI *et al.*, 1998), and there is a possibility that this species, although preferring deeper waters (bathyal bottoms), in the future might also be found in shallower waters further to the north or closer to the coast.

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Nalaz vrste *Neorossia caroli* (Jouben, 1902) u srednjem Jadranu (hrvatske vode)

Svjetlana KRSTULović ŠIFNER*, Igor ISAJLOVIĆ i Nedo VRGOČ

Institut za oceanografiju i ribarstvo, P.P. 500, 21 000 Split, Hrvatska

** Kontakt adresa, e-mail: sifner@izor.hr*

SAŽETAK

Dva primjerka vrste *Neorossia caroli* po prvi put su nađena u hrvatskim vodama. Ulovljeni su u ljeto 2004. godine dubinskom povlačnom mrežom – kočom, tijekom jednog potega, na dubini između 449 i 594 m. Vrsta do sada nije zabilježena na području srednjeg Jadrana, te ulovljeni primjerci ujedno predstavljaju najsjeverniji nalaz ove vrste u Jadranskom moru. Nađene jedinke bile su spolno zreli mužjaci, dužine plašta 42 i 37 mm, u kojima je nađeno 21 odnosno 16 spermatofora. U radu se iznose osnovni morfometrijski podaci ulovljenih primjeraka, uključujući dimenzije kljuna.

Ključne riječi: Cephalopoda, Sepioidea, *Neorossia caroli*, najsjeverniji nalaz, Jadransko more
